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The Vegetation of Cliffy Island, Victoria, Australia

By G. S. Hope† and G. K. Thomson*

Abstract: 41 Vascular plant species, 8 bryophyte species and 10 lichens have been found at Cliffy Island which lies about 12 miles E. of Wilsons Promontory. Nearly half of the vascular plants are aliens, a much higher proportion than is known for other Bass Strait islands, and this is due to the presence of a manned light station on the island. Six plant communities are described and mapped and species lists given for each. The *Poa poiformis* closed tussock grassland is discussed in the light of previous work and is regarded as a climax community of some small islands.

INTRODUCTION

Cliffy Island is the easternmost island in the Seal or Discovery Group which consists of five granite islands lying about 12 miles E. of Wilsons Promontory and about 15 miles S. of Port Albert. Sealers visited Cliffy Island during the period 1800-1920, but no permanent dwellings were established until 1884 when the light station was erected. At present this consists of three houses, a radio shed, a foghorn shed and the lighthouse. Stores are landed at the north of the island and brought to the station by a cable trolley. Rubbish and sewage are dumped over the cliffs but waste water is allowed to drain onto the NW. slope. Soon after the station was established goats were introduced onto Seal Island about 2 miles N. of Cliffy Island, to act as an emergency food supply, and descendants of these animals are still running wild. According to lighthouse staff, however, no grazing animals have ever been introduced to Cliffy Island. There are no records of any fires on the island.

A plant census with brief notes on the island was published by Gillham (1961) as part of her investigation into possible relationships between sea birds and vegetation on several Promontory islands. Further information on the vegetation of the island was required for a study of pollen deposition being undertaken by one of us (GSH) on this and nearby areas. The vegetation was studied in May and November 1967 during field trips to service the pollen trap set on the western side of the island. Fig. 1 includes a sketch map of the island with approximate contours and boundaries of the plant communities. Although these boundaries are estimated, some control of the mapping was obtained from small scale aerial photographs. The scale was derived from 'Sailing Directions for Victoria including Bass Strait' (1959) which records the dimensions as 400 yd E.-W., 300 yd N.-S. and the maximum height as 142 ft. These indicate that the island is about 35 acres in area; the area of 100 acres given by Gillham (1961) is apparently in error while the height of 180 ft she recorded refers to the elevation of the top of the lighthouse.

GEOMORPHOLOGY AND CLIMATE

The island is a humped granite mass with sheer cliffs up to 100 ft in height on the southern and eastern sides. To the NW. the land slopes gently into the sea. Much of the granite is fairly coarse-grained and similar to that found on parts of Wilsons Promontory, but dikes of fine grained granite and zones of contortion and jointing are frequent. A cleft which is only 6 ft wide but over 60 ft deep has formed in one of these zones. This cleft intersects the coast at the eastern end of the island and a small boulder beach occurs there. This is the only area on the coast not swept clear of detritus by wave action. The weathering of numerous joint cracks gives an irregular surface to the cliff tops and the lower NW. slopes, but the remainder of the surface is smooth and rounded, with a little gravelly sand forming a soil between bare granite sheets and boulders.

The coast is exposed to swell from the SW. to NE. and the deep water (20 fathoms) around

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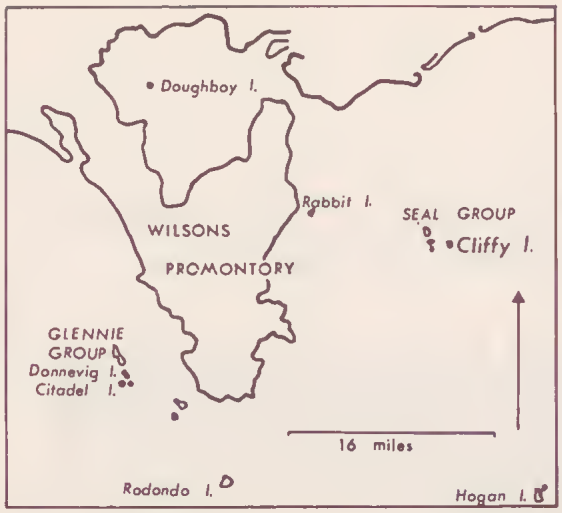

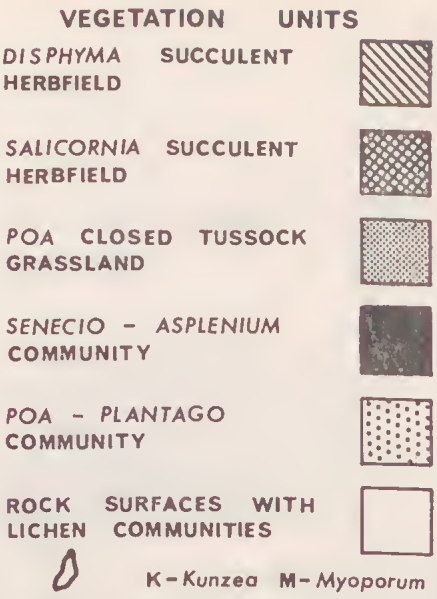

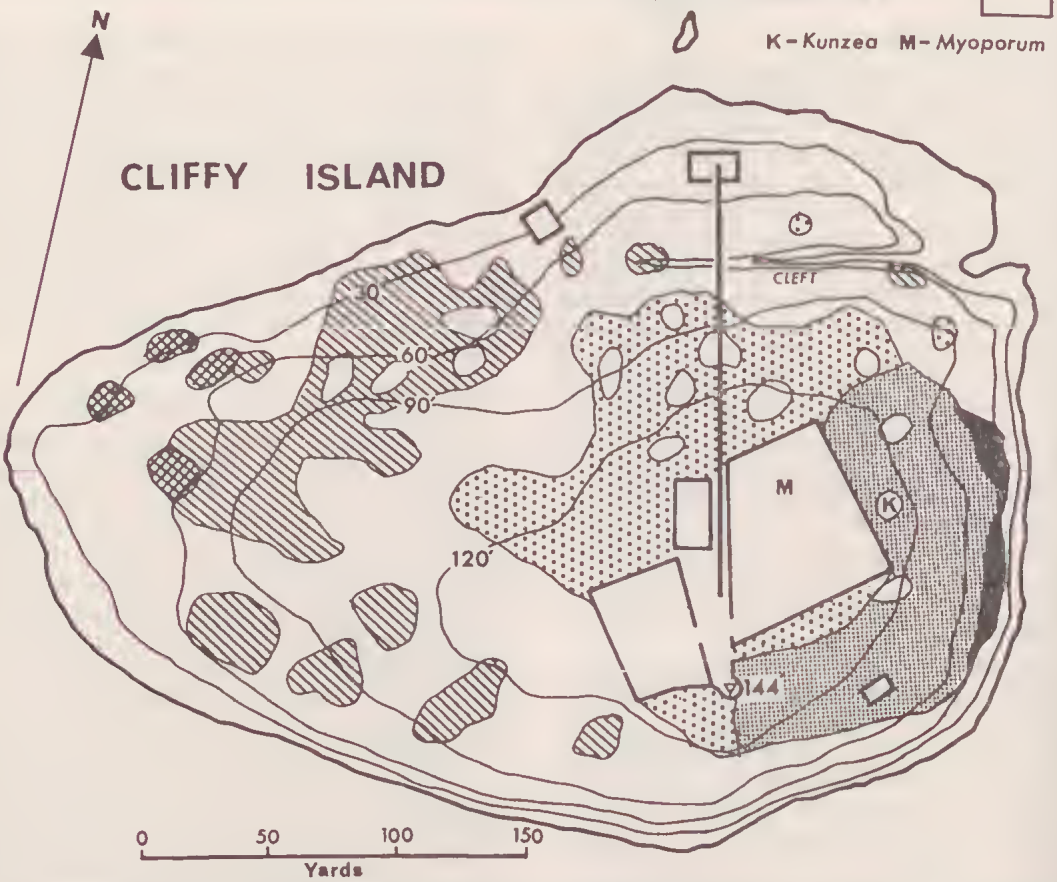

FIG. 1—Distribution of vegetation on Cliffy Island. Inset shows the location of some of the islands mentioned in the text.

Cliffy Island allows direct wave attack on the cliffs. During storms in which wave and wind directions (mainly E. or SW.) coincide, spray falls over the whole island. Conditions at Cliffy Island are probably similar to those of the Wilsons Promontory lighthouse (inset, Fig. 1), which is the nearest station at which weather records are kept. The annual precipitation there is about 41 in. and strong winds from the W. and E. are common. However, unlike Cliffy Island, this station is sheltered from the N. and subject to an orographic increase in precipitation, so that rainfall on Cliffy Island is probably intermediate between the Promontory figure and the annual mean for Port Albert which is 28 in.

FLORISTICS

The census of vascular plants, bryophytes and lichens in Appendix 1 includes the records of Gillham. The list of 10 lichen species is probably incomplete. Those found are all fairly common colonists of bare rock surfaces. It is interesting that *Caloplaca murorum* (Hoffm.) Th. Fr. is missing from the list, for this lichen forms a characteristic orange zone on rocks exposed to salt spray in Tasmania and the Tasmanian Bass Strait islands. Although the species has been reported in Victoria, the most northern point at which this zone has been noted is at Hogan Island which lies 30 miles S. of Cliffy Island.

Eight moss species are recorded but no liverworts, and with the exception of *Bryum microerythrocarpum* these mosses are apparently all of wide occurrence on the smaller Bass Strait islands. *Bryum microerythrocarpum* is a recent segregate from the *B. chrysoneuron* C. Muell. complex, and is known from only two collections in SE. Victoria. F. von Mueller collected *B. chrysoneuron* from Wilsons Promontory in 1850 (J. H. Willis, pers. comm.) and undoubted *B. microerythrocarpum* has been found there recently by one of us (GKT). Although the only previous record of *Barbula australasiae* is from Big Green Island in the Furneaux Group (Norman 1966) it is probably common but is readily overlooked due to its small size and resemblance, when sterile, to other small mosses. Gillham (1961) has recorded *Campylopus introflexus* (Hedw.) Brid. on three granite islands, Citadel, Dannevig and McHugh, and it is curious that it was not found on Cliffy Island which is of similar size.

Of the 41 vascular species only three are not herbs. One is the only fern species, *Asplenium obtusatum*, which occurs as a robust succulent maritime form around the cliff tops. Two shrub species, *Myoporum insulare* and *Kunzea ambigua* are present, as single specimens only, in the shelter of walls and buildings. The best represented family is the Poaceae with eleven species including the tussock-forming grass *Poa poiformis* which is characteristic of the Bass Strait islands, although it occurs in coastal areas as well. Other species commonly found on the islands include *Pelargonium australe, Apium prostratum* (as the robust form), *Lavatera plebeia, Disphyma australe,* and *Bulbine semibarbata.* Records for the genus (*Bulbine*) may be inadequate. Both *B. semibarbata* and *B. bulbosa* are common on Wilsons Promontory (Ewart 1909). Gillham (1961) however recorded only *B. semibarbata* from the islands that she visited and Norman (1967) recorded only *B. bulbosa* from Rabbit Island. (See inset Fig. 1 for location). Since both species are superficially similar and occupy similar habitats, it is probable that both species occur throughout the islands and that further collections are required. On any one island, however, one or other species may predominate.

Eighteen of the forty-one herbaceous species are aliens. These include nine of the grass species and three composites. This is a much higher proportion than that recorded for other islands around Wilsons Promontory by Gillham (1961) or Norman (1967). On some islands further to the south where some grazing has taken place one third of the vascular flora may be made up by aliens, as at Hogan Island and at Big Green Island (Norman 1966).

Gillham (1961) compared eight islands around Wilsons Promontory on the basis of their ratios of species numbers to acreage. She also ranked the islands with a subjective estimate of their exposures, presumably based on their distance from other land and shelter from wave attack, and found a fair correlation between high exposure and a low species to acreage ratio. The ratio for Cliffy Island appeared anomalously high when compared with that of Rabbit Island which lies in a much less exposed position close to Wilsons Promontory. The ratios are of limited use (except where the islands compared are similar in size, geology and general location, as in this case) but the correlation with exposure can be improved if the native species only are considered. The ratios in Table 1 were derived by using all species (after Gillham 1961), and with native species only (using new records by Norman, 1967, for Rab-

TABLE 1

APPROXIMATE SPECIES TO ACREAGE RATIOS

Island	*Acreage*	*All Species*	*Native Species*
Citadel	70	1 : 8	1 : 8
Dannevig	80	1 : 4	1 : 4
Cliffy	35	1 : 1	1 : 2
Rabbit	90	1 : 2·5	1 : 3
Doughboy	10	8 : 1	5·5 : 1

bit Island), and the islands are ranked in the order of exposure suggested by Gillham.

Cliffy Island has been preferentially enriched with alien species because of greater opportunities for introduction and the creation of new niches (increased water and protection by walls). This has marked effect on the species to acreage ratios, and the ratio calculated with native species gives the best correlation only with an estimate of exposure.

VEGETATION

Six vegetation communities have been mapped on Cliffy Island and their boundaries are shown in Fig. 1.

(*a*) *Disphyma australe* Succulent Herbfield
(*b*) *Salicornia quinqueflora* Succulent Herbfield
(*c*) *Poa poiformis* Closed Tussock Grassland
(*d*) *Senecio lautus—Asplenium obtusatum* Community
(*e*) *Plantago coronopifolia—Poa poiformis* Community
(*f*) Rock Surfaces with Open Lichen Colonies (indicated by blank area on map).

In classifying and mapping coastal vegetation units such as these, the established definitions of structural forms by e.g. Beadle and Costin (1952), Wood and Williams (1960) are insufficient, and the terms used here require further explanation. Most authors use the term 'herbfield' in the context of 'Alpine herbfield', but the definition 'a closed community dominated by perennial herbs, including forbs and grasses' is appropriate for non-alpine communities. In the case of Cliffy Island, such herbfields are dominated by succulent-leafed herbs and the term 'succulent herbfield' has been used. The tussock grassland found on Cliffy Island fits structurally into the category of 'wet tussock grassland' of Beadle and Costin, but does not occupy the habitat defined for this form. The term 'closed tussock grassland' has thus been used, as it carries no environmental implications. The last three of the communities listed above have not been classified structurally as they are variable internally and do not appear to coincide with any established definitions. In the descriptions which follow the projective cover and species frequencies have been estimated and are not quantitative measures.

(*a*)

Disphyma australe SUCCULENT HERBFIELD

Disphyma australe forms a close sward of vertical succulent leaves arising from branching ground-hugging stems. The height varies from 1-15 cm and the cover varies with the luxuriance of growth. The main occurrence is on the W. and NW. slopes from 10 ft above sea level to 120 ft, though the best development occurs below 80 ft. Above 50 ft a few associated species including *Lobelia alata, Sonchus oleraceus* and *Hypochoeris radicata* become conspicuous. As noted by Gillham, the *Disphyma australe* is red and stunted in sites exposed to the S. and E. and robust where it occurs in sites sheltered from the wind on the W. and N. aspects. The herbfield is associated with extremely shallow soils on well drained slopes and covers many areas of rock too steep to retain soil. On the steep eastern cliffs, areas of vertical sward give way to isolated stands of *D. australe* in the *Senecio-Asplenium* community at the cliff top. Elsewhere the boundaries are distinct.

(*b*)

Salicornia quinqueflora SUCCULENT HERBFIELD

This herbfield is similar in structure to the *Disphyma* succulent herbfield although the sward is made from succulent photosynthetic stems which arise from stolons. The herbfield is restricted to a few small areas on the western side of the island within 35 ft of sea level. Here the spray collects in hollows on a gentle slope and *Salicornia quinqueflora* has colonised these shallow pools and drainage runnels. There appear to be no associated species in the herbfield and the boundary between the *Disphyma australe* on the well-drained slopes and the *Salicornia quinqueflora* is distinct.

(*c*)

Poa poiformis CLOSED TUSSOCK GRASSLAND

Poa poiformis is a tough tussock forming grass giving a grassland of separated tussock bases and densely interlacing erect leaves. The tussock bases are usually 40 cm in diameter and spaced 20-40 cm apart and the grassland may be up to 1 m high, although it is usually from 30 cm to 60 cm. This grassland is restricted as a closed community to the south eastern area of the summit of the island on gentle slopes, from 90 to 130 ft above sea level. The soil attains a maximum depth over this area, with organic rich sands and sandy loams reaching an average depth of 20 cm, but boulders and surface outcrops are still common. A small colony of mutton birds nest in the area and these birds have burrowed into the bases of the tussocks, trampled pathways through the grass, and presumably 'enriched' the soil with their droppings.

Within the closed tussock grassland other vascular species are rare but include *Pelargonium australe* and *Hypochoeris radicata*. All eight species of moss were recorded from the area, either in moist areas between the tussock bases or bare areas next to rock sheets and boulders where

drainage from the summit would be concentrated. *Thuidium furfurosum* is occasional in a somewhat stunted form among the tussocks. *Sematophyllum homomallum* is very rare, and restricted to this grassland, although it is a fairly common coloniser of the edges of granite rock sheets on Hogan Island and Wilsons Promontory. At the boundaries of the community, the tussocks are reduced in size and separated by bare ground. Some of the introduced grass species and *Plantago coronopus* occur here.

(*d*)

Senecio lautus—Asplenium obtusatum COMMUNITY

A robust succulent form of *Senecio lautus* and the fern *Asplenium obtusatum* are associated with occasional *Poa poiformis* tussocks and plants of *Disphyma australe* along the cliff tops of the eastern side of the island. The community may represent an ecotonal change from *Disphyma* succulent herbfield to closed tussock grassland. The community is restricted to the jointing cracks with relatively deep soil where there is some shelter. *Apium prostratum, Bulbine semibarbata* and several species of introduced grasses are also present in the community which is very variable structurally, with a wide range of cover and local stands dominated by *Senecio lautus,* grasses or *Disphyma australe.*

(*e*)

Plantago coronopus—Poa poiformis COMMUNITY

This community, which occurs on the northern area of the summit, approaches an open to very open tussock grassland in structure, with occasional *Poa poiformis* tussocks up to 20 cm in height. However, *Plantago coronopus* is very frequent and it has a greater cover in the community than does the *Poa poiformis.* Much of the area is occupied by isolated plants with the grasses *Parapholis incurva* and *Hypochoeris radicata* as common sub-dominants. Most of the introduced plants occur in this community, generally in the shelter of walls or buildings or in the area where drainage water is released. The soils are very shallow and dry and there are large areas of bare rock. In some places *Spergularia media* and *Sagina apetala* have trapped soil particles and built up a few centimetres of soil around their stems and leaves, which remains even when the plants are dead. The boundaries of this community are zones a few metres wide in which the cover and frequency of *Plantago coronopus* varies so that the change from closed tussock grassland is indistinct.

(*f*)

ROCK SURFACES WITH OPEN LICHEN COLONIES

Only the main areas of rock are shown by the blank zones on Fig. 1; in addition to these, scattered patches of rock occur in all the other communities. Most rock surfaces from 6 ft above sea level on the NW. aspect and from 40 ft on the southern and eastern aspects have lichen cover. The characteristic red *Caloplaca cinnabarina* occurs in the lowest zone where saltspray is intense. Other crustose lichens including *Buellia* sp. *Lecidea* sp., and *Lecanora* sp. are found above the *Caloplaca* zone. On rocks higher than 60 ft above sea level foliose lichens become abundant. *Parmelia* sp. cf. *conspersa* and the orange *Xanthoria ectanea* both grow luxuriantly, the latter sometimes in association with another orange fruiticose species, *Teloschistes spinosus.* The crustose *Caloplaca elegans* and a further *Parmelia* species are found on the summit area of the island.

DISCUSSION

The extensive occurrence of *Poa poiformis* tussock grassland on some islands of Bass Strait has been regarded by some authors as a post-European settlement phenomenon. Guiler (1967) studied original surveys of islands in the Furneaux Group and concluded that on many of the smaller islands tussock grassland had replaced an extensive shrubland following burning, clearing and the introduction of rabbits. Norman (1967) gave evidence of an extensive shrub cover on the sheltered side of Rabbit Island and suggested that the tussock grass community, at present covering most of the island, was formerly restricted to a coastal belt. The shrubs were removed by fire and regeneration prevented by rabbits. Norman cited the case of Rodondo Island (inset Fig. 1) as an example of shrub and woodland development in the absence of fires (Bechervaise 1947). However this island is over 1000 ft high and shrub species do not occur in the salt spray zone below 300 ft so that it cannot be compared with Rabbit Island which attains only 194 ft. Islands comparable to Rodondo Island, such as Curtis Island and Deal Island also have extensive shrublands, despite frequent fires. As previously noted, the species to acreage ratio for Rabbit Island does not demonstrate that any great depletion of species has occurred there and it is possible that tussock grassland has always dominated the exposed (south eastern) side.

Gillham (1962) suggested that the occurrence of *Poa poiformis* tussock grassland is due to its tolerance of both salt spray and trampling by sea birds which could prevent shrub or heath species from colonising. These two factors are complementary; in sheltered areas trampling and guano deposition would have to be heavy to prevent a shrub overstorey from developing while in very exposed areas these disturbances might lead to a

breaking up of the closed grassland with consequent erosion. Gillham also suggested that guano may be necessary for the maintenance of healthy grassland. One problem with this view of *Poa poiformis* closed tussock grassland as sea-bird dependent is that on many islands areas of grassland may be found without associated rookeries. Gillham (1962) has suggested that these areas may have been the sites for older rookeries.

It seems likely that Cliffy Island has supported tussock grassland for a long time. Of the shrubs on the island the *Myoporum insulare* has been introduced, and it is possible that the *Kunzea ambigua* has also been deliberately planted, as it is known that plants have been exchanged by the light keepers at Wilsons Promontory and Cliffy Island. At present there are no signs of regeneration nor of traces of older plants, so that if native, it may have grown from seed from Wilsons Promontory, reaching one of the few sites favourable for its establishment on the island. The other islands in the Seal Group appear to be equally unsuitable for shrubs. No shrubs could be detected on the aerial photographs and none could be seen when the islands were inspected by field glasses from a boat close to their shores.

These islands, unlike Cliffy Island, appear to carry closed tussock grassland over most of their surfaces and no areas similar to the *Poa-Plantago* community were seen. This suggests that this community may be a recent development on Cliffy Island and result from burning and trampling of closed tussock grassland, followed by soil erosion around the light station and the invasion by introduced species. The rookery covers only part of the closed tussock grassland area today but may have been more extensive in the past. The introduced grasses have not formed a closed grassland.

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Appendix:

PLANT SPECIES OCCURRING IN EACH OF THE COMMUNITIES

Key

1—*Disphyma australe* succulent herbfield
2—*Salicornia quinqueflora* succulent herbfield
3—*Poa poiformis* closed tussock grassland
4—*Senecio lautus—Asplenium obtusatum* community
5—*Poa poiformis—Plantago coronopus* community
6—Bare rock areas with open lichen colonies.
*—Introduced species
†—not recorded by Gillham (1961)
‡—not recorded by the authors.

SPECIES	1	2	3	4	5	6
Lichens (†)						
Buellia sp.						+
Caloplaca cinnabarina (Ach.) Zahlbr.						+
Caloplaca elegans (Link) Ach.						+
Lecanora sp.						+
Lecidea sp.						+
Parmelia sp. cf. *conspersa*						+
Parmelia sp.						+
Teloschistes spinosus (Hook. f. & Tayl.) J. Murray						+
Xanthoria ectanea (Ach.) Räs. ex R. Filson						+
Bryophytes						
† *Barbula australasiae* (Hook. et Grev.) Brid.			+		+	
† *Bryum argenteum* Hedw.			+		+	
B. billardieri Schwaegr.			+		+	
† *B. capillare* Hedw.			+			
† *B. microerythrocarpum* C. Muell. et Kindb.			+			
† *Sematophyllum homomallum* (Hamp.) Broth.			+			

SPECIES	1	2	3	4	5	6
† *Thuidium furfurosum* (Hook. f. et Wils.) Jaeg.			+			
† *Tortella calycina* (Schwaegr.) Dix.			+			
Tortula princeps De Not			+		+	
Vascular Plants						
ASPLENIACEAE						
Asplenium obtusatum Forst. f.				+		
AIZOACEAE						
Disphyma australe (Ait.) N. E. Brown	+			+	+	
APIACEAE						
Apium prostratum Labill. ex Vent. (= *A. australe*)				+		
ASTERACEAE						
Cotula coronopifolia L	+				+	
Gnaphalium candidissimum Lam.					+	
G. luteoalbum L.					+	
* *Hypochoeris radicata* L.			+	+	+	
Senecio aff. *lautus* Forst f. ex Willd.				+	+	
‡**Sonchus asper* (L.) Hill				+		
* *S. oleraceus* L.	+				+	
CAMPANULACEAE						
Lobelia alata Labill.	+					
CARYOPHYLLACEAE						
Polycarpon tetraphyllum (L.) L.					+	
* *Sagina apetala* Ard.					+	
Spergularia media (L.) Presl.					+	
CHENOPODIACEAE						
* *Atriplex hastata* L.					+	
Salicornia quinqueflora Bung. ex Ung. Sternb.		+				
CRASSULACEAE						
Crassula sieberiana Ostenf.					+	

SPECIES	1	2	3	4	5	6
FUMARIACEAE						
‡ *Fumaria officianalis* L.						
GERANIACEAE						
Pelargonium australe Willd.			+	+	+	
JUNCACEAE						
‡ *Juncus bufonius* L.						
LILIACEAE						
Bulbine semibarbata (R. Br.) Haw.				+	+	
MALVACEAE						
Lavatera plebeia Sims				+	+	
* *Malva parviflora* L.					+	
MYOPORACEAE						
† *Myoporum insulare* R. Br. (cultivated)						
MYRTACEAE						
Kunzea ambigua (Sm.) Druce					+	
PLANTAGINACEAE						
* *Plantago coronopus* L.			+		+	
POACEAE						
* *Bromus diandrus* Roth.				+	+	
* *B. mollis* L.			+		+	
†**B. unioloides* H.B.K.					+	
Cynodon dactylon (L.) Pers.				+	+	
* *Hordeum leporinum* Link.			+		+	
* *Lagarus ovatus* L.					+	
* *Lolium perenne* L.					+	
* *Parapholus incurva* (L.) C. E. Hubbard					+	
†**Pennisetum clandestinum* Hochst. ex Chiov.					+	
Poa poiformis (Labill.) Druce			+	+	+	
* *Vulpia bromoides* (L.) S. F. Gray				+	+	
POLYGONACEAE						
‡**Rumex crispus* L.						
PORTULACACEAE						
‡ *Calandrinia calyptrata* Hook. f.				+	+	
PRIMULACEAE						
* *Anagallis arvensis* L.					+	